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Public opinion on renewable energy technologies and climate change in Peninsular Malaysia

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ABSTRACT

The development of renewable energy policies is necessary to ensure secure and sustainable energy supplies at reasonable costs and to address issues related to global climate change. Since the year 2000 in Malaysia (time of the 8th Malaysian Plan), renewable energy has been included as a key fifth element in the country's fuel policy along with hydro, coal, gas, and oil, and a target of obtaining 5% of the total energy supply from renewable sources was set, although it has not yet been reached.

This work explores public opinions regarding climate change and renewable energy in Peninsular Malaysia. Probability sampling and a stratified technique were used to conduct a survey with subjects aged 20 years and over with higher education qualifications. The results showed that the majority of Malaysians are concerned about climate change and have heard about renewable energy. However, only two out of five people in Peninsular Malaysia have used renewable energy products. This finding can be explained by the high price of renewable energy products, lack of knowledge about government policies, and ineffective programs and initiatives.

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1. Introduction

The federation of Malaysia came into existence in 1966. Malaysia's equatorial climate has a year-round average temperature in the range of 20–35 °C and relative humidity in the range of 80–90%; the timing of the rainy season on the peninsular coast varies [1]. Since attaining independence, in moving towards becoming an industrialised country, the energy sector has played a considerable role in the Malaysian economy. Therefore, the energy policy in Malaysia is revised from time-to-time to meet the country's energy demands.

In the First Malaysian Plan (1966–1970) establishing an extensive and efficient electricity and water supply system were the main concerns of the government; as a result, there was rapid growth in the power generation capacity under the first Malaysian plan [2]. The period of 1970–1980 marked the introduction of the New Economic Policy (NEP). The NEP aimed to promote growth with equity. In the context of the NEP, the Second Malaysia Plan (1971–1975) paid particular attention to power supply development and the energy sector. Some important policies were also formulated within this period. In 1974, the Malaysian national oil company (PETRONAS) was incorporated, being entrusted with the entire rights and control of the petroleum resources in the country. The formation of PETRONAS was the first policy that really impacted the industry [3]. In 1976, the Third Malaysian Plan (1976–1980) was launched, with the overall philosophy of maintaining a balance between development and environmental conservation [4]. Within this framework, appropriate measures have been taken to ensure that the development of the energy sector is adequate to meet the projected demands of industry, commerce and domestic consumption [5]. For the sake of achieving economic development, the National Petroleum Policy was formulated to regulate the requirements of the oil and gas industries in 1975. Four years later, as the most significant energy policy, the National Energy Policy was launched in 1979 and identified objectives in the energy supply, utilisation of energy, energy consumption, and minimisation of any negative environmental impacts in the energy supply chain [6]. In 1980, the National Depletion Policy (NDP) was

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incorporated into the National Petroleum Policy (NPP) to regulate the production of major oil fields and to preserve oil and natural gas field development [7].

In view of the increasing cost of fuel since 1973, in the Fourth Malaysian plan (1981–1985), the main target of the energy sector was to reduce the countries' over-dependence on petroleum for electricity generation by utilising other alternative sources, such as hydro power and gas [8]. In 1981, the government launched the Four Fuel Strategy to reduce the country's over-reliance on oil and to find the best balance among the four types of energy sources: oil, natural gas, hydropower and coal [7]. During the Fifth Malaysia Plan period (1991–1995), a major development in the energy was attained, which involved a rapid diversification in the supply [9].

The 6th and 7th Malaysian Plan covered the period of 1991–2000. During the Sixth Plan period, the focus of the energy sector was on ensuring adequate and reliable supplies of energy as well as utilising the resources efficiently while recognising environmental considerations. The nation's strategic movement to reduce its dependence on oil as an energy resource resulted in the rapid development of environmentally friendly natural gas [10]. Sustainable development of energy resources was undertaken during the 7th Plan period (1996–2000). In this regard, the development of renewable energy started to be assessed [11]. The 7th Malaysian plan also focused on the sustainable development and the diversification of energy resources and on ensuring the adequacy of generating efficiency [12]. As a result of two decades of implementation of the Four Fuel Policy, the success of the fuel switch was remarkable for electricity generation. The share of oil in the mix was reduced tremendously, while the portion of gas markedly increased (see Fig. 1).

In 2001, policy makers in Malaysia have begun “a strategic initiative to address the issue of fossil fuel depletion and adverse climate changes” [14]. The Fifth Fuel Policy was launched during the 8th Malaysian Plan (2001–2005), and the government set a target to obtain 5% of its energy from renewable sources by 2005. However, this policy ended up achieving only 0.3% of the target by the year 2005 [15]. The same target of 5% renewable energy was again set in the 9th Malaysia Plan (2006–2010). Nonetheless, the renewable energy goal was not achieved, and so far, only 8.3% of the target has been reached [14].

Even though the target for Peninsular Malaysia is 300 MW, and that for Sabah and Sarawak is 50 MW, only 56.7 MW of energy in Malaysia is produced from renewable energy sources [12]. This means that after 10 years of implementing renewable energy policies, the share of renewable energy in Malaysia's total generated electricity is still less than 1% [16].

This situation raises important questions about the types of barriers that are associated with the development of renewable energy in Malaysia. For example, what are the factors that influence Malaysian residents' acceptance and adoption of renewable energy? Addressing this issue is essential because learning from experience is fundamental in promoting the development of renewable energy. Renewable energy development remains a key concern of the Malaysian government. In the 10th Malaysian Plan (2011–2015), the government aimed to achieve a renewable energy target of 985 MW by 2015, or 5.5% of Malaysia's total electricity generation mix. Concurrently, the National Renewable Energy Policy was also launched in 2010, which set a target for 11% of the total energy to come from renewable sources (2080 MW) by 2020.

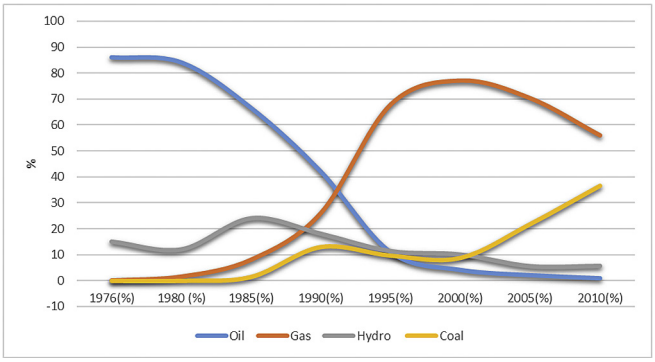

Fig. 1. Energy mix in Malaysia, 1976–2010 (%).
Sources: [13].

A considerable amount of literature has been published on the RE situation in Malaysia and other ASEAN (Association of Southeast Asian Nations) countries. Several attempts have been made to address the barriers of renewable energy use in the ASEAN countries in broad ways, without providing specifics on the situation in Malaysia (e.g., [17–19]). The studies that focus on the renewable energy situation in Malaysia do not scrutinise the failures of the RE policy in the 8th and 9th Malaysian plans. [3], for example, discussed the overall approach in addressing the energy challenges and the complexity of existing energy policies in Malaysia by focusing on a green technology policy, launched in 2009 [20]. explored the current energy scenario and the use of alternative energy in Malaysia, and they predicted that in the near future the country would not be ready to shift from traditional resources to renewable energy [21]. Investigated the significant challenges to implement one of the main renewable energy programs in Malaysia, entitled “Small Renewable Energy Power (SREP) Program”.

Although such reviews have addressed some important aspects of the renewable energy situation in Malaysia and other ASEAN countries, to date, very little information could be found in the literature regarding the views of society on issues related to climate change and renewable energy technology in Malaysia.

It is important to note that the literature has emphasized the importance of public opinion during energy policy planning. Surveys such as the one conducted by Ref. [22] have shown that in Australia, citizens with environmental knowledge were eager to proceed with the adoption of green technologies. A similar study in this area is the work of [23] who reported that households are affected by psychological, social, and institutional factors.

Conversely, citizens who are opposed to environmental action can pose a considerable barrier to the implementation of renewable energy projects. In addition, the environmental behavior of members of a society cannot be easily influenced by state policies and incentives [24]. In order to minimize the problems and maximize the expected results, and prior to strategic plans being drawn up and governmental decisions taken, it is imperative to research public opinion. In this way, the possibility of failed governmental decisions can be minimized [25].

In this study, first, we attempt to identify the key characteristics of public opinion toward renewable energy and climate change in Peninsular Malaysia. Second, by applying a theoretical framework we explore the impact of cost, knowledge and trust on the public's intention to use of renewable energy.

2. Research framework

Based on [37] citizen–opinion surveys with a hypothesis-based approach, complex and competitive results have been produced. Moreover, based on the mentioned surveys, an integrated framework is developed. This framework is comprised of four variables: cost, knowledge, trust and intention to use of REt initiative (where REt stands for renewable energy technology) (Fig. 2).

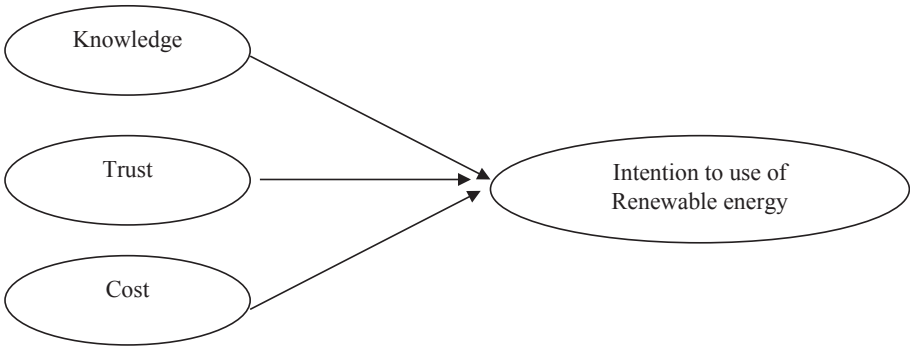

Fig. 2. Conceptual framework.

The existing literature of renewable energy development emphasizes the importance of public's knowledge about specific technology on intention to use of that technology [41]. A number of researches also consider the effects of cost on intention to use of renewable energy [42–44]. In terms of trust [38–40] indicate that trust in the actors responsible for the technology, affected acceptability or intention to accept and use of renewable energy.

The conceptual framework of the present research includes three main hypotheses to be tested.

H1. Knowledge of renewable energy technologies has effects on the intention to use of renewable energy technologies.

Nation-wide face-to-face interviews were conducted during the period from June 2014 to August 2014, and a total of 748 valid samples were collected. Based on an estimation of 95% reliability, the maximum sampling error was 2.95%.

The subject were residents of Peninsular Malaysia and were citizens aged 20 years and over with higher education qualifications. This study employed probability sampling and a stratified technique to collect the data. The samples for this study were collected from four regions (the north, south, east coast, and central regions) in Peninsular Malaysia, and the stratification technique was an appropriate method to apply in this case. The proportions of sampled elements were allocated across the four regions of Peninsular Malaysia as follows: north region, 23%; central region, 28%; south region, 27%; east coast region, 22%.

The questionnaire designed for this study include four parts. The first three parts cover the items comprising the constructs in the proposed theoretical model while the final part covers aspects of demographics. The first three parts of the questionnaire reflect the underlying constructs. These constructs were presented in this instrument utilizing a 5-point Likert type scale.

2.1. Sample characteristics

The sample was approximately 44% female and 56% male, defined by sampling method. Age ranged from 21 to 79 years old, with a mean of 27 years (below 30 (51%), 30–40 (22%), 41–50 (14%), 51–60 (10%), 60 and older (3%). The income ranged from below 1000 RM monthly to over 5000 RM, with a mean of approximately 1800 RM (1 ¼ below 1000 RM (18%), 1001–2000 (28%), 2001–3000 (19%), 3001–4000 (14%), 4001–5000 (10%), 5001 and above (11%). For ethnic group there are 68% Malaysian, 24% Chinese and 8% Indian.

2.2. Data analysis

For data analysis, SPSS (Statistical Package for the Social Sciences) was employed to provide descriptive analysis and data screening before testing the hypothesis.

To test the hypotheses of this study, structural equation modelling (SEM) using AMOS 19.0 (Analysis of Moment Structures) was applied. The SEM method is a multi-variate statistical technique that is often used to confirm causal relationships among latent variables. The SEM was conducted by using the two-stage approach recommended by [45] the model fit was determined through goodness-of-fit indices. The significance of paths was determined through the use of coefficient parameter estimates.

3. Results

3.1. Public opinion about climate change

This research found that the majority of Malaysians (69.75%) are concerned about climate change. This results suggest that the level of concern regarding climate change in Malaysia is high, with only 12% of the public stating that they were not at all concerned about climate change. Likewise, [27] stated that 71% of the UK population were concerned about climate change.

This study also finds that the terms climate change evoke different free associations among the public in Peninsular Malaysia.

Respondents were asked: “When you think of climate change, what is the first word or phrase that comes to your mind?” The results of this study also show that the term climate change more elicits more associations to weather and rain. Over three-quarters of respondents (77%) thought that climate change evokes more associations to Weather and 68% thought that climate change refer to rain (See Fig. 3).

Respondents than asked to give their opinion about factors that cause climate change by choosing from a list of topics. Analysing the data indicated that 81% of respondents believe that the main cause of climate change is a human activity; while 19% think that natural processes alone is a cause of climate change. Among a list of four human activities 32% of respondents think climate change are caused mostly by emissions from vehicle and motorcycle, (23%)

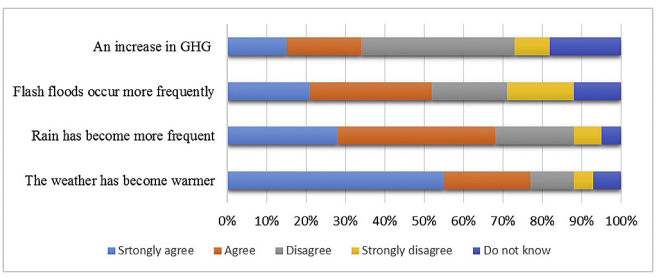

Fig. 3. Climate change associations.

believe that hazardous fumes form factories is a cause of climate change and (14%) and (12%) think that excessive burning of fossil fuel and excessive use of electricity are the main cause of climate change respectively (Fig. 4).

The analysis of data shows that nearly three-quarters (76%) of the respondents have heard about renewable energy products. However, only 42.5% of the respondents have ever used renewable energy products. These findings clearly show that the respondents are aware of renewable energy products on the market, but often, they do not use them in practice. At the regional level, we found that respondents in the central region are more likely to have heard about green products (80%), followed by subjects in the east coast (78%), north (77%), and south (72.8%) (See Fig. 5). This demonstrate that percent use of Ret (renewable energy technology) products is highest among those who are familiar with such products, i.e., 68.3% who use green products said that they were familiar with the product compared to only 19.1% who have been using green products but have no knowledge of them. Furthermore, the percentage of respondents who do not use these products was higher among those who have never heard of these products (80.9%).

3.1.1. Knowledge about REt initiative

Regarding the Knowledge of REt initiative undertaken by the government, only 57% of the respondents said that they knew about the initiative (Fig. 6). At the regional level, the residents in the central region (61.6%) have heard more about this government initiative, while the subjects in the south have heard of it less (51.9%).

3.1.2. Knowledge about RE sources

In response to the question "To your knowledge, can the following resources be used as renewable energy sources?" The majority of the participants (90%) responded that sun and water can be considered as renewable energy resources. It means that sun and water technologies are the most acknowledged, while nuclear and geothermal remain the least known. Biomass, remains better known than wind power in these cases (See Fig. 7). This finding is in line with the findings of [31].

Most of the public felt that the price of renewable energy products was expensive (81%) (Fig. 8). At the regional level, a large number of respondents in the central region said that they think green products are expensive (84%), as did respondents in the north (81%), east coast (81%), and south (78%) (see Fig. 9).

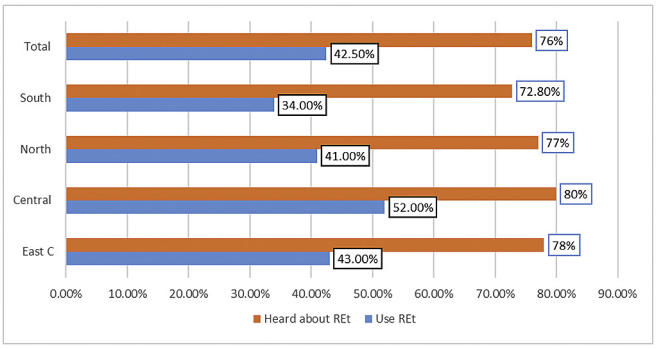

Fig. 5. Respondents who have heard about REt and use REt.

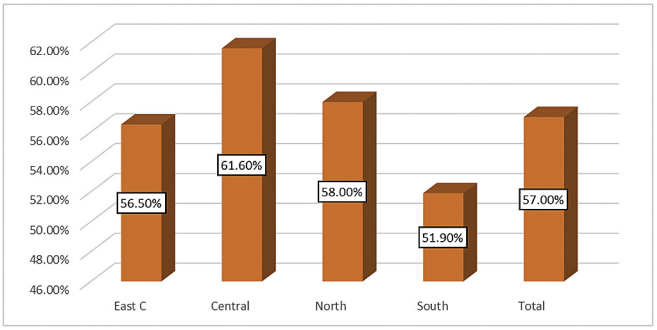

Fig. 6. Respondents who have heard about government initiatives involving green technology.

3.1.3. Environment impact of RE

Almost three quarter of the participants (77.1%) said that they believe renewable energy products have a positive impact on the environment, while 22.9% disagree that these kind of products has

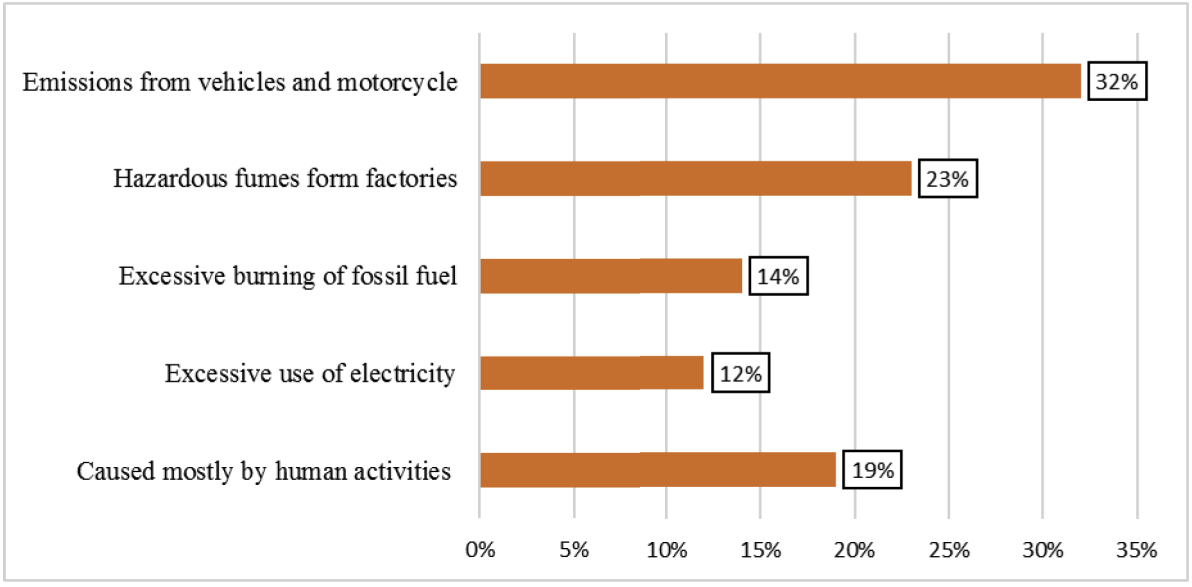

Fig. 4. Cause of climate change.

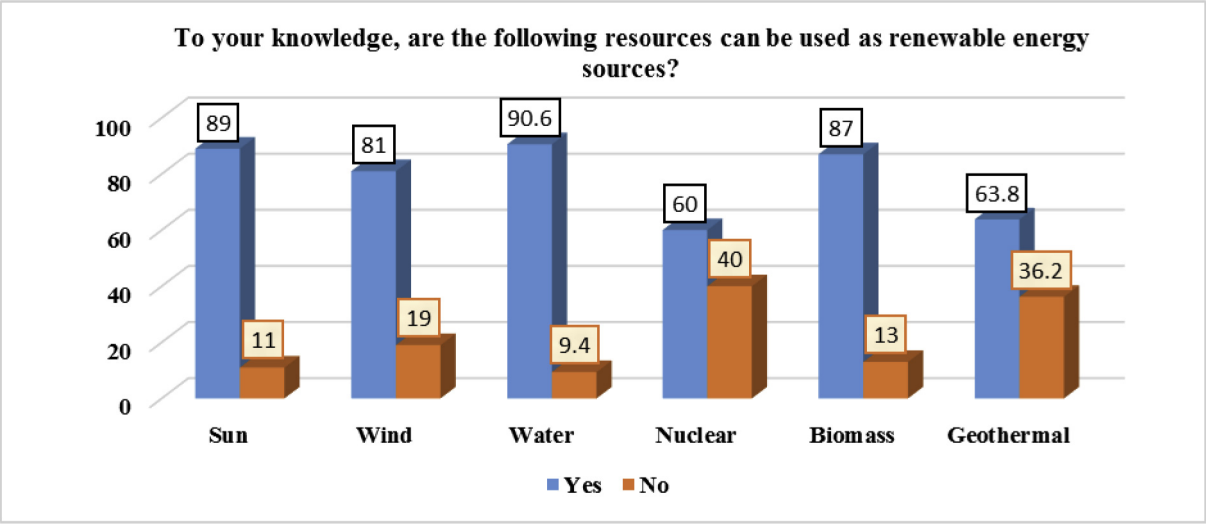

Fig. 7. Knowledge about RE sources.

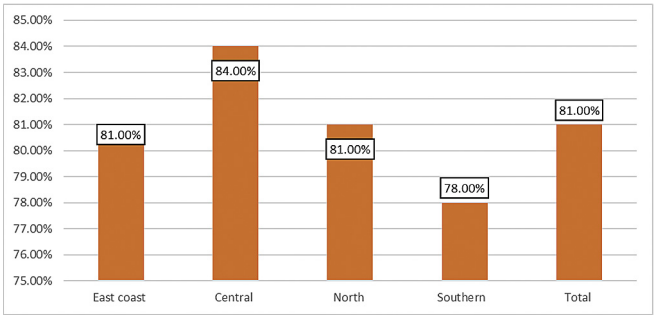

Fig. 8. Perceptions about the price of green technology.

positive impact on the environment.

Table 1 shows some of the policies that have been implemented by the government over the past few years to support the country's green technology policy. Based on this analysis, most of the respondents had never heard of or do not know about the policies that have been implemented. Data show that all policies except the National Green Technology Policy (55.3%) and National Energy Master Plan (52.6%) are associated with a low percentage of knowledge, i.e., less than 50%. The Sustainable Energy Development Authority Act of 2011 was the most unknown by the general public (38.6%), followed by the Framework for Low Carbon Cities (40.5%), the Renewable Energy Policy and National Action Plan of 2009 (42.1%), and the Investment Tax Exemption (43.1%). Other policies were associated with only slightly higher levels of knowledge.

3.1.4. *Level of effectiveness of the policies*

In another question, the public was asked about whether they are of the view that the policies and programs carried out by the government are successful or not. Over half of those surveyed (55.9%) thought that the policies were not successful, compared to 44.1% who said that they were successful. Hence, the public largely believes that the government's efforts did not succeed, and these findings are consistent with a low level of knowledge about the existence of policies and programs that have been undertaken by

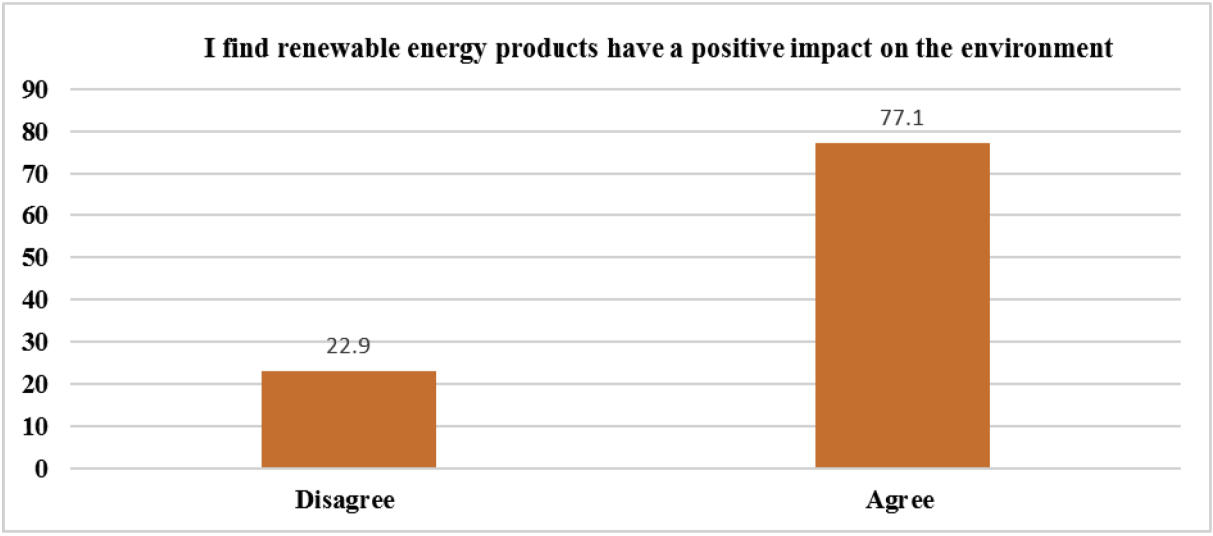

Fig. 9. Environmental impact of RE.

Table 1
Awareness about the policies initiated by the government.

Have you heard of the following policies initiated by the government	Percentage of respondents who answer yes
National Green Technology Policy	55.3%
National Renewable Energy Policy and Action Plan 2009	32.1%
Renewable Energy Act 2011	36.0%
Sustainable Energy Development Authority Act 2011	38.6%
Investment Tax Allowance (ITA)	43.1%
National Energy Master Plan	52.6%
Clean Development Mechanism (CDM)	44.2%
Electric Vehicle Infrastructure Roadmap	44.9%
Low Carbon City Framework	40.5%
Green Lane Policy for Innovative Malaysian, SMEs[a]	43.3%
National Land Public Transport Master Plan	47.4%
Feed-in-Tariff for Renewable Energy	39.1%
Low Energy Office (LEO) Building	42.1%
Green Building Index (in cooperation with the private sector)	46.9%

[a] SMEs, small and medium enterprises.

the government.

According to Table 4, which shows the results for a question where the respondents were asked to provide a value for their perceived level of failure for government policies and programs, more than 68.5% said that the level of failure of government policies and programs was at a high level (scale 3–5), i.e., at this scale, the policies and programs were judged to be not successful. Only 31.5% said that the failure rate was low (scale 1–2). These data clearly show that the majority of the public view government policies and programs as failures.

3.1.5. Support for renewable energy

The vast majority of the public support renewable energy; 68% believe it is a 'good idea', compared to just five per cent who disagree. The major conclusions can be drawn from this results is that the attitude of respondents is generally positive towards renewable energy technologies.

Structural equation modelling (SEM) is used to test the hypotheses arising from the theoretical model (see Fig. 10). In SEM path diagram can be used for presenting the hypothesized model. The SEM diagram for this study can be seen in Fig. 11 which is consisted of four constructs including knowledge, cost, trust and intention to use of renewable energy.

In SEM, to determine how well the sample data fit the theoretical model global omnibus tests of the fit of the model are available.

To evaluate the structural model, goodness-of-fit indices are examined to assess if the hypothesized structural model fits the data. There are three model fit categories named incremental fit, absolute fit, and parsimonious fit [46,47] for testing the hypothesis we have to use at least one indicator from each category. In this research, As outlined in Table 3, the three indices include (GFI) which is the measure that indicates the relative amount of variance and covariance together [48], the comparative fit index (CFI) which compares the covariance matrix predicted by the model to the observed covariance matrix, and the normalized chi-square ($\chi 2$/df)

Table 2
Level of unsuccessfulness of policies.

	Percentage (%)		Mean	Std.deviation
	Scale 1–2, Low Level	Scale 3–5, High level		
To what extent are policies/programs run by the government not successful?	31.5	68.5	3.0	0.389

Table 3
Goodness-of-fit indices.

Name of Index	Category	Level of Acceptance	Index Value	Comment
GFI	Absolut fit indices	GFI $\geq$0.90	0.91	The required level was achieved
RMSEA	Absolut fit indices	RMSEA $\leq$0.08	0.0546	The required level was achieved
CFI	inferential fit index	CFI $\geq$0.9	0.982	The required level was achieved
χ^2/df	parsimonious fit indices	χ^2/df $\leq$ 0.5	4.451	The required level was achieved

Table 4
Results for hypothesis.

Construct	Path	Construct	P-Value	Result	Result for Hypothesis
Intention to use of RE	←	Cost (H_1)	0.017	Significant	Supported
Intention to use of RE	←	Knowledge (H_2)	0.007	Significant	Supported
Intention to use of RE	←	Trust (H_3)	0.009	Significant	Supported

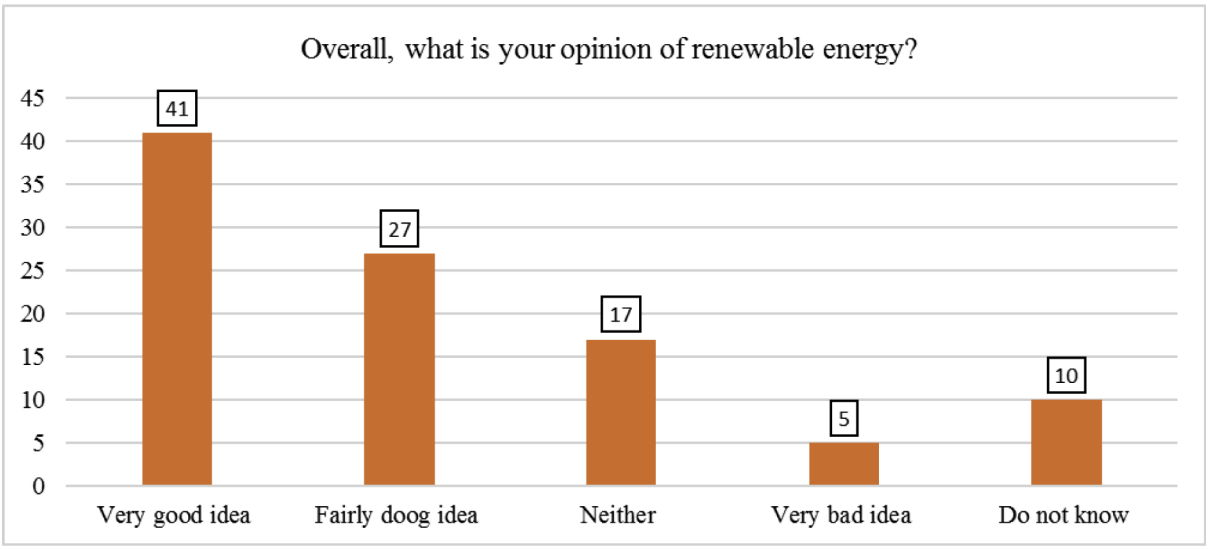

Fig. 10. Support for renewable energy.

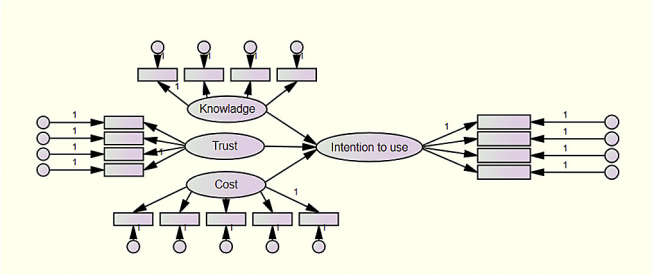

Fig. 11. Path diagram.

which evaluates the appropriateness of the model [46].

All fit indices suggest that the covariance structure constructed in the substantive model fits the data acceptably (according to the [47] acceptable fit thresholds, which are given in Table 3 for each fit index).

As presented in Table 4, these hypotheses are represented in three paths (H1, H2 and H3) to determine the relationships between the constructs in the adopted model.

In testing the hypothesized model, the results presented in Table 4 indicate that the hypotheses H1, H2, H3 were statistically significant and in the hypothesized direction. Thus, these hypotheses were supported. The indices for goodness-of-fit demonstrate that this model fits the data adequately.

In this study, the objective of the structural model was to test the hypotheses in order to address the research questions discussed above.

From the results, it can be seen that cost has a statistically significant, positive (0.017), and direct impact on attitudes toward using renewable energy. The results of this study also demonstrate that the knowledge has a statistically significant, positive (0.007), and direct impact on attitudes toward using renewable energy. In terms of trust, results show that it has a statistically significant and direct impact on intention to use of renewable energy (0.009).

4. Discussion

This particular paper aimed to depict the attitudes of Peninsular Malaysian citizens on a series of issues related to climate change and renewable energy and explore the impact of public's knowledge about RE, public's perception about cost of RE and public's trust to policymakers toward public intention to use of RE.

In this study based on citizen survey a conceptual framework has been drown and it was hypothesized that knowledge, cost and trust have impact on public intention to use of renewable energy.

The current study found that the cost of renewable energy has direct impact on public intention to use of renewable energy. It means that public perception about the cost of renewable energy is one of key elements to encourage or discourage them for using RE technologies. In terms of cost another finding was that the most of the respondents believed that the price of renewable energy products was expensive in the Malaysian context. This means that in terms of economic issues, it can be said that the economic ethos of Malaysia is not presently supportive of renewable energy developments, especially for providing a balance between costs and benefits. This result is also in agreement with the findings of [32], which showed the front-end cost for renewable energy technology was comparatively higher in comparison to conventional energy technology in Malaysia.

In the economic realm, it is worth mentioning in Malaysia it has been reported that “Subsidies for conventional fossil-fuel generated electricity, create a strong economic disadvantage for RE technologies which generally face high up-front project capital costs” [33]. It is also believed that “‘hidden’ subsidies for fossil fuels in host countries can be a barrier to renewable energy systems, making it difficult for them to compete economically” [34].

Modelling results also indicted that knowledge of people has direct impact on their intention to use renewable energy. One related finding to knowledge was that there is a high level of awareness (69%) among the public about climate change. Other researchers also have stated that the general level of awareness and understanding among Malaysians on environmental issues is satisfactory [26]. In contrast to earlier findings, however, the results of this study show that the knowledge of the public about the renewable energy technologies and policies and programs undertaken by the government is low. It should be noted that social acceptance of renewable energy technology is an essential element for developing renewable energy policies. Considering this point, the fact that the majority of the public in Peninsular Malaysia does not have knowledge about renewable energy policies may explain

the failure of renewable energy policies in Malaysia because when there is no knowledge about renewable energy policies, there is no social acceptance for renewable energy [34]. Indicated that if potential end users are not aware of the services that renewable energy technology and policies can provide, there will be no demand for them. What was interesting in analyzing the respondents' answers was the findings that not only had many of them never heard about the government policies and programs involving renewable energy, but among those who did have information about these policies, the majority believed that the renewable energy policies and programs carried out by the government were not successful. The current study also found that the relationship between knowledge and use of renewable energy products is directly proportional. Thus, if the knowledge of renewable energy products can be improved among the consumers in Malaysia, one may be able to increase the use of these products. Similarly, if knowledge about these products is not increased, then the rate of use of these products will also be reduced. This finding is consistent with the studies of [30] who found that caring for the environment ranks higher than practicing green consumerism among the consumers in Petaling Jaya. Lack of knowledge is likely related to inadequate research and development (R&D) activities. After announcing the Fifth Fuel Policy and setting the 5% target for renewable energy, the government budget appropriations for environmental R&D should have increased, but the opposite occurred. In 2002, the total R&D expenditure in Malaysia was 0.69% of the GDP, while in 2006 this figure declined to 0.64% of the GDP. In the energy sector, government R&D programs and R&D pursued by utility companies play a vital role in generating knowledge [49].

According to this study, we can infer that curriculums in schools and universities are still not comprehensive and are therefore less able to raise awareness and knowledge of policies and programs related to the environment. This finding has important implications for developing suitable programs about renewable energy technology and environmental issues in Malaysian schools and universities. This result is consistent with the study conducted by Ref. [35] who reported that there is no specific subject on environmental education in secondary school syllabuses and at the tertiary level; the syllabuses do, however, incorporate to a certain extent environmentally related topics and contents.

In line with studies of [28,29] that employed the technique of asking the following question: “When you think of global, what following statements come to your mind?” In this study, this question was asked of the respondents and the results show that the term climate change elicits significantly more associations to weather and rain. This question generates a rich dataset of free associations that can then be categorized into common themes.

Another important finding was that public's trust in the actors responsible for the technology has direct effect on intention to use of renewable energy by public. This further support the idea of [50] who reported that trust in actors who are responsible for the technology have been found to influence citizens' perception of benefits of the relevant technology. Table 2 shows that majority of citizens in Peninsular Malaysia thought that the programs and policies which are undertaken by government in related to RE are unsuccessful. It is apparent from this results that only two third of people do not have trust in governmental actors that are responsible for developing renewable energy technologies. A possible explanation for this might be that, in Malaysia the environment and context in which the renewable energy policy is developed are not supportive.

It is important to note that in the policymaking process political culture, socioeconomic conditions, and participants such as those working with mass media, interest groups, citizen initiatives, elites, and civil society are the elements that can affect the successfulness or unsuccessfulness of specific policies. Therefore, if renewable energy policy in Malaysia wants to be successful, it will be inevitable to take into consideration all the above-mentioned factors that have made it difficult for renewable energy technologies to compete economically. It can thus be suggested the lack of public intention to use of renewable energy technology in Peninsular Malaysia is likely related to high cost of renewable energy, shortage of knowledge about renewable energy and lack of trust to governmental actors of renewable energy.

5. Conclusions and policy implications

This study set out to determine public opinion about renewable energy and climate change as well as investigated the potential barriers for developing renewable energy policy in Malaysia. Data were collected from all over Peninsular Malaysia.

This study shows that citizens in Peninsular Malaysia are adequately informed about the issue of climate change. The results also show that the percentage of the public who use renewable energy products is highest among those who are familiar with such products. This research extends our knowledge of the role of renewable energy costs in public acceptance of renewable energy technology. The most obvious finding to emerge from this study was that four out of five people in Peninsular Malaysia believe that the cost of renewable energy products is high. Moreover, this study found that the public's knowledge about government policies involving renewable energy is low, and the majority of people who have information about these policies felt that they are not successful and effective.

These findings suggest that, in general, we need to introduce modules on renewable energy technology at all school levels in Malaysia and make other efforts to increase public awareness, such as through suitable programs and campaigns on mass media and social media.

It appears that both economic barriers and non-economic barriers both play a role in hindering the development of renewable energy policies in Malaysia. An implication of this is that distortionary subsidies for fossil fuel consumption and production should be removed and shifted to renewable energy.

The findings of this research also provide insights into the influence of public opinion on governmental renewable energy policy. The present study confirms previous findings that report about “levels of government activity on environmental issues will correlate with changing levels of public opinion support for environmental protection” [36] and contributes additional evidence that suggests that the government has to increase the role of non-government stakeholders and participants in renewable energy policy development. Taken together, these results suggest that for renewable energy policy success in Malaysia, it is inevitable to take into consideration the relationship between renewable energy policy and public opinion.

A key policy priority should therefore be to plan for applying renewable energy campaigns by interest group (companies and private investors). It should be noted that Interest group plays an important role in policy making area. Because interest group has an interest to influence policy, this group can persuade ordinary citizens to use specific technology and to serve as their front line advocates.

Companies, corporation and private sectors have high intentions to encourage people for using renewable energy technologies. High public intentions for using renewable energy products can be considered as win-win situation for both companies and government.

In this framework one suggested policy could be the interaction among these companies and government in offering new

renewable energy schemes and projects. In other words, these companies should present their renewable energy promotion slogans in all the advertisement in a creative way. Meanwhile, the government by assistance of academic communities could assess the interest of society to the offered schemes and allocate exclusive reward to the best one. The advantage of this policy is the benefit for all three important activists (government, companies and end users). The government allocates exclusive award scheme to guaranteed schemes, companies would receive more benefits in a competitive situation and costumers could choose the best schemes in a competitive situation.

The renewable energy policies under the 8th and 9th Malaysian Plans did not meet their targets. Having said that, the lessons learned from the failures of the Fifth Fuel Policy can be used to effectively improve future plans and programs, especially the 10th Malaysian Plan and the Malaysian National RE Policy that was launched in 2010. One of the most important lessons is the requirement for overcoming both economic and non-economic barriers. The subsidies for fossil fuels. From the analysis of the opinions of the respondents, it can be said that best way to overcome these barriers is that the government should play a powerful leadership role. In this regard, further work is required to explore the applicability of applying a green tax policy and a green subsidy reform program by the Malaysian government as a useful policy for overcoming the subsidy barrier. More research is also needed to determine how social acceptance for renewable energy can be created in the Malaysian multi-ethnic society and to determine how non-government organizations and the media can play a role in this area. The current study examined public opinion about climate change and renewable energy policies in Peninsular Malaysia (west Malaysia). It is recommended that further research be undertaken by collecting data from east Malaysia.

For future research to expand the research model and apply other SEM path diagrams, questions that could be asked might be include influence of additional external variables (independent) such as experience, personal and social norms on accepting Re technology.

Selection of other dependent variables like behavioural intention and actual usage of RE technology rather than attitude toward using RE could be another direction for further research.

This study only concentrations on citizen' perspectives in terms of RE technology acceptance rather than consumer, stockholder and businessmen. Hence, any future study could be grappling with all related groups.

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